Space Environmental Effects (SEE)

Engineering Directorate Technology Thrust Area

Marshall Space Flight Center (MSFC) • Huntsville, Alabama

Space Environmental Effects (SEE) is a high emphasis technology activity of the Engineering Directorate. The goal of this thrust area is to provide technical expertise and the lead testing facility for the agency in space environmental effects. Team members of SEE work to define and simulate space environments and to conduct materials testing and development for spacecraft. In partnership with industry, academia, and other government agencies, the SEE thrust area team provides technology solutions to reduce cost and increase mission lifetime.

International Space Station (ISS)

Materials Experiment on ISS

Technology Spotlight

SEE Offers Complete Capabilities

The SEE team offers unique capabilities of not only **defining** and **simulating** space environments but also **developing** and **testing** materials and systems for these environments.

Defining space environments for a mission is crucial to determining and combating the hazards a spacecraft may encounter. The SEE team has developed environmental models such as the Interplanetary Environment Model and the Magnetotail Environment Model. This technology reduces environment uncertainty and allows for enhanced mission preparation.

The SEE team also **simulates** space environments in order to provide an accurate lifetime prediction of materials and systems. Environments simulated include solar UV, atomic oxygen, particle radiation, thermal, micrometeoroid/debris and plasma. Synergistic effects are studied through flight experiments and ground testing. Through these efforts team members analyze the effects of contamination and expand existing knowledge of total environmental effects.

SEE team members use their expertise to **develop** materials and systems that are more resistant to space environments. They also improve methods of materials processing and develop more robust materials and systems.

The SEE team is equipped with world-class analytical tools and laboratory **testing** facilities. These capabilities are used to develop in-flight material measurements and to provide material characterization. With these tools, team members are developing new technology solutions and capabilities to provide safe, low-cost access to space.

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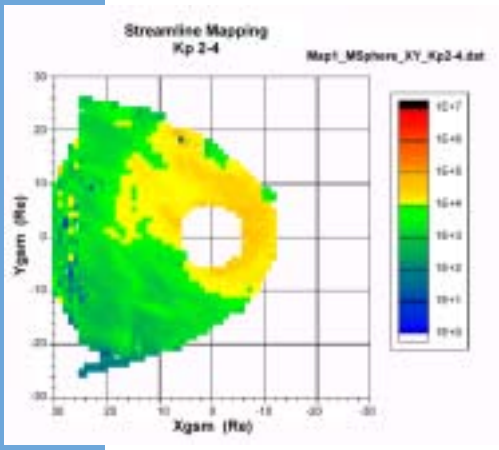
Additional SEE Technologies

Outer Magnetosphere Charged Particle Environment



The SEE team has developed the first engineering model of the outer magnetosphere charged particle environment. This empirical model uses physics principles such as stream-line mapping to fill in between spacecraft measurements. This innovative concept allows engineers to better anticipate and manage materials damage caused by these environments. The Chandra X-ray Observatory, for example, has used this model to manage the degradation of the Advanced CCD Imaging Spectrometer detector (ACIS). SEE team members also develop other space environment models as needed for specific missions.

Stream-line mapping technique used to extrapolate data

Development of Plasma Simulations Systems and Techniques

Propulsive Small Expendable Deployer System (ProSEDS) Plasma Contactor

In order to predict and combat the effects of plasma environments, SEE team members have developed plasma simulation systems. A spacecraft traveling through an ionized portion of the atmosphere may encounter plasma flux that can charge the surface and disrupt the operation of electrically biased instruments. Plasma simulation technology is primarily used for flight experiments and ground testing of materials and systems. These tests allow the added assurance that spacecraft, particularly those with high voltage solar arrays and tethers, will function properly in the surrounding plasma environment. Several customers already utilize this capability. For example, the International Space Station (ISS) uses this technology to determine minimum voltage breakdown in plasma and for the Floating Potential Measurement Unit (FPMU) qualification testing at MSFC.

Combined Environmental Effects Testing

Combined Environmental Effects System

In order to support various NASA missions, it is crucial to be able to simulate the various environments that spacecraft will experience. The SEE team provides a unique laboratory capability at MSFC to simultaneously expose materials and components to a range of combined environments. Synergistic effects of this combined exposure can produce effects that are greater than the additive effects of the individual environments. Therefore, testing for these effects increases the safety of NASA missions.